GAS TURBINE ENGINE ASSEMBLY AND METHOD OF ASSEMBLING SAME

BACKGROUND OF THE INVENTION

This invention relates generally to gas turbine engines, and more specifically to gas turbine engine assemblies and methods of assembling the same.

At least some known gas turbine engines include a fan assembly, a core engine, and a low-pressure or power turbine. The core engine includes at least one compressor, a combustor, and a high-pressure turbine that are coupled together in a serial flow relationship. Air entering the core engine is mixed with fuel and ignited to form a high energy gas stream. The high energy gas stream flows through the high-pressure turbine to rotatably drive the high-pressure turbine and thus the compressor via a first drive shaft. The gas stream expands as it flows through the high-pressure turbine to facilitate driving the low-pressure turbine which rotatably drives the fan assembly through a second drive shaft.

To improve engine efficiency, it is desirable to operate the fan assembly at a relatively low speed to improve fan efficiency and to operate the high-pressure turbine at a relatively high speed to improve turbine efficiency. Accordingly, neither the fan speed nor the high-pressure turbine speed may be totally optimized to improve overall engine efficiency.

As such, at least one known gas turbine engine includes a gearbox coupled between the low-pressure turbine and the fan assembly to facilitate reducing the operational speed of the fan assembly. However, utilizing a gearbox to reduce the speed of the fan assembly and thus increase the efficiency of the fan assembly reduces the quantity of airflow channeled to the booster compressor. As a result, additional stages may be added to the booster compressor to achieve proper pressure, thus increasing the overall weight, design complexity and/or manufacturing costs of such an engine.

BRIEF DESCRIPTION OF THE INVENTION

In one aspect, a method of assembling a gas turbine engine is provided. The method includes coupling a low-pressure turbine axially aft from the core gas turbine engine, coupling a fan assembly axially forward from the core gas turbine engine, and coupling a booster compressor to the low-pressure turbine such that the booster compressor and the low-pressure turbine rotate at a first rotational speed.

In another aspect, a turbine engine assembly is provided. The turbine engine assembly includes a core gas turbine engine including a high-pressure compressor, a combustor, and a turbine. The turbine engine assembly also includes a low-pressure turbine coupled axially aft from the core gas turbine engine, a fan assembly coupled axially forward from the core gas turbine engine, and a booster compressor coupled to the low-pressure turbine such that the booster compressor and the low-pressure turbine rotate at a first rotational speed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a cross-sectional view of a portion of an exemplary turbine engine assembly; and

FIG. **2** is an enlarged cross-sectional view of a portion of the turbine engine assembly shown in FIG. **1**.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1** is a schematic illustration of an exemplary gas turbine engine assembly **10** having a longitudinal axis **11**. Gas

turbine engine assembly **10** includes a fan assembly **12**, and a core gas turbine engine **13** that includes a high-pressure compressor **14**, a combustor **16**, and a high-pressure turbine **18**. In the exemplary embodiment, gas turbine engine assembly **10** also includes a low-pressure turbine **20** and a booster compressor **22**.

Fan assembly **12** includes an array of fan blades **24** extending radially outward from a rotor disk **26**. Engine **10** has an intake side **28** and an exhaust side **30**. Booster **22** and low-pressure turbine **20** are coupled together by a first drive shaft **31**, and compressor **14** and high-pressure turbine **18** are coupled together by a second drive shaft **32**. Fan assembly **12** is supported on a novel frame **126** and driven by shaft **31** through reduction gearbox **100**.

FIG. **2** is a schematic diagram of a portion of gas turbine engine assembly **10** shown in FIG. **1**. As shown in FIG. **2**, booster **22** includes a plurality of circumferentially-spaced inlet guide vanes (IGV) **34** to facilitate channeling airflow entering gas turbine engine **10** downstream through booster **22**. In the exemplary embodiment, gas turbine engine assembly **10** also includes a plurality of outlet guide vane (OGV) assemblies **36** that are coupled downstream from booster compressor **22**. In one embodiment booster **22** includes less than four stages **40** of rotor blades **42** that are each coupled to a respective rotor disk **44**. In the exemplary embodiment, booster compressor **22** includes two stages **40** of rotor blades **42**.

In the exemplary embodiment, booster **22** is coupled to low-pressure turbine **20** via shaft **31**. For example, in the exemplary embodiment, gas turbine engine **10** includes a cone or disk **50** that is connected at a first or forward end **52** driven by shaft **31** utilizing a plurality of splines **76**, and at a second or aft end **54** to disk **44**, as shown in FIG. **2**. As such, booster **22** is coupled to low-pressure turbine **20** such that booster **22** and low-pressure turbine rotate at the same rotational speed in a first rotational direction **60**. More specifically, gas turbine engine **10** includes a shaft extension **70** that includes a first or forward end **72** that is coupled to disk **50** and a second or aft end **74** that is coupled to drive shaft **31**, and thus low-pressure turbine **20** via splines **76**.

In the exemplary embodiment, gas turbine engine **10** also includes a gearbox **100** that is coupled between fan assembly **12** and drive shaft **31** to facilitate rotating fan assembly **12**. In one embodiment, gearbox **100** is an epicyclical gearbox that is configured to rotate fan assembly **12** in opposite rotational direction **62** with respect to rotational direction **60** in which low-pressure turbine **20** and booster **22** each rotate. Gearbox **100** has a generally toroidal shape and is configured to be positioned circumferentially about drive shaft **31** to extend substantially about drive shaft **31**. As shown in FIG. **2**, gearbox **100** includes a support structure **102** that is configured to provide structural support to gearbox **100** such that gearbox **100** is maintained in a substantially fixed position within gas turbine engine **10**. As such, gearbox **100** includes an input **104** that is coupled to shaft **31** via shaft extension **70** and an output **106** that is coupled to fan assembly **12** to facilitate driving fan assembly **12**.

In the exemplary embodiment, gas turbine engine **10** also includes a flex connection **108** that is coupled between input **104** and shaft extension **70** to facilitate providing both axial and radial support between gearbox **100** and shaft **31**. For example, during operation, flex connection **108** may absorb any rotational torque that is transmitted between gearbox **100** and shaft **31** to facilitate extending the operational life of both gearbox **100** and shaft **31**. Moreover, flex connection **108** may also be utilized to facilitate aligning gearbox **100** and shaft **31** during engine operation.